

1. Sediment – Pond 1 and West Tributary

RAO: Prevent human and ecological direct and ingestion exposures to the sediment with concentrations of contaminants of potential concern (COPCs) exceeding the lead preliminary remediation goal (PRGs) of 200 mg/kg.

RAO: Minimize migration of sediment COPCs into the ground water, surface water, and Sand Creek

Lead: 200mg/kg (residential and ecological)

Justification:

- Pond is adjacent to the lead additive area and received run-off containing concentrations of lead exceeding the ecological risk and the surface water quality criteria
- This tributary is routinely dry and is considered accessible as soil
- The pond and tributary discharge surface water and sediment containing concentrations of lead to Sand Creek.
- Calculated lead PRG for blood lead levels not exceeding 5% chance of 5ug/dL for residential child

2. Soil

RAO: Prevent human and ecological direct and ingestions exposures to the soils with concentrations of contaminants of potential concern (COPCs) exceeding the residential and ecological lead PRG of 200 mg/kg and the industrial lead PRG of 400 mg/kg.

RAO: Minimize migration of soil COPCs into the ground water, surface water, sediment, and other site soils

Lead: 200mg/kg (residential and ecological)

Lead: 400 mg/kg (industrial areas on Wilcox process area)

Justification:

- Calculated lead PRG for blood lead levels not exceeding 5% chance of 5ug/dL for residential child.
- Calculated lead PRG for blood lead levels not exceeding 5% chance of 5ug/dL for industrial worker: locations exceeding 400 and 500 mg/kg are identical. The 400mg/kg is the industrial PRG for not exceeding 5% chance of 5ug/dL blood lead and the PRG for residential blood lead levels not exceeding 5% chance of 10ug/dL blood lead

Place holder for Benzo(a)pyrene pending additional review

RAO: Prevent human direct and ingestion exposures to the soil with concentrations of contaminants of potential concern (COPCs) exceeding the benzo(a)pyrene PRG of (.12 resident at 10-6 or 1.2 mg/kg resident at 10-5)

Benzo(a)pyrene additional review.

It is noted that the HHRA evaluated potential residential human health risks based on exposure to the entire exposure area within each of the 5 site operational areas. However, these exposure areas are larger than areas that are typically evaluated as a residential yard. To further evaluate the surface soil medium of concern and potential concerns related to smaller exposure areas (i.e., potential residential yards), sample results were reviewed to determine if areas of high concentration are present within the five site operational areas. Areas of high concentration were identified for benzo(a)pyrene; therefore, there is a potential that isolated areas may be a potential human health concern for residential receptors.

To evaluate this, these areas of high concentrations were further delineated to represent typical residential lots and potential risks were evaluated.

Summary of Risk Findings

Human Health

- The risk assessment determined that excess cancer risks associated with exposures to site media (except ground water) under any of the scenarios evaluated for any of the 5 site areas did not exceed the EPA acceptable cancer risk range (1×10^{-6} to 1×10^{-4}). Excess Cancer risks are within or less than the risk range and did not exceed 1×10^{-4} ; therefore, health concerns related to excess cancer risks are not expected and no remediation based on excess cancer risk exposures are proposed.
- The risk assessment determined that excess cancer risks associated with exposures to surface water and sediment did not exceed the EPA acceptable cancer risk range (1×10^{-6} to 1×10^{-4}) and that the noncarcinogenic hazards were below the level of concern (<1). Excess Cancer risks are within or less than the risk range and did not exceed 1×10^{-4} while noncarcinogenic hazards were below the level of concern (<1); therefore, no remediation based on excess cancer risk or non-cancer risk exposures are proposed.
- The risk assessment determined that excess cancer and non-cancer risks associated with exposures to ground water are present under the residential and industrial scenarios; therefore, remediation based on excess cancer risk or non-cancer risk exposures are proposed.
- Lead concentrations in surface soil within the Lorraine Process Area and Wilcox Process Area revealed greater than 5% chance of the population (child resident) exceeding all reference blood-lead levels (5, 8 and 10) evaluated in the IEUBK. Remediation based on lead exposures is proposed for residential areas.
- The adult lead model indicated that the 5 $\mu\text{g}/\text{dL}$ reference blood-lead level had greater than 5% chance of the population (adults) exceeding in the Lorraine and Wilcox Process Areas. Remediation based on lead exposure is proposed for industrial areas.

- The risk assessment determined that non-cancer risks associated with exposures to soil through the ingestion of home produce and beef are present for all areas, and is primarily associated with the metals cobalt, iron, and copper. These metals are sporadically detected across the soil medium, are collocated within proposed remediation areas, and are less than background (cobalt and copper). There is a high degree of uncertainty in the models because these pathways model potential health impacts from surface soil concentrations rather than actual produce and/or beef concentrations. Due to uncertainties associated with uptake from soil and the conservative assumptions in the model, the results presented here are likely an overestimation of potential risk. None of these metals were identified as significant contributors to risk or as significant contributors based on target organs. As such, these metals are not considered COPCs, and no remediation based on these metals is proposed.

Ecological

- The risk assessment determined that potential risks associated with exposures to lead in site soil (all 5 areas) are present for plants, insectivorous mammals, insectivorous birds, and herbivorous birds. Areas of concern are collocated with human health remediation areas; therefore, remediation based on an ecological lead exposure PRG is not proposed for soil.
- The risk assessment determined that potential risks associated with exposures to vanadium in the site soil (all 5 areas) are present for plants and insectivorous birds. Areas of concern are collocated with human health remediation areas; therefore, remediation based on an ecological vanadium exposure PRG is not proposed for soil.
- Potential risks to aquatic organisms in the ponds (cadmium, lead, BaPyrene) and streams (manganese) from elevated concentrations of constituents in the water column are likely to be reduced following removal of contaminated soil in the uplands. No remediation based on potential risks associated with surface water is proposed.
- Concentrations of Total PAHs in stream sediment, when compared to the probable effects level (PEL) of 16.8 mg/kg (MacDonald et al 1996) indicates no potential risk to benthic organisms from total PAHs in stream sediments; therefore, no remediation based on potential risks to benthic invertebrates from PAHs is proposed.
- Because of infrequent detections of volatile organic compounds, the volatile nature of the chemicals, the absence of direct toxicological studies, and the unsubstantiated theoretical nature of the soil screening values, it is not expected that these VOCs would result in unacceptable risk to populations of soil invertebrates; therefore, no remediation based on potential risks to soil invertebrates from VOCs is proposed.
- It is unlikely that there would be adverse impacts to the plant or soil invertebrate communities at the site from sporadic elevated concentrations of metals (zinc, manganese, copper, and chromium) based on the following, and as a result, no remediation based on potential risks to plants or soil invertebrates is proposed.
 - Low HQs identified in the SLERA, based solely on a screen against EcoSSLs or screening benchmarks from Efroymsen et al. (1997a,b).

- Low potential for uptake and toxicity from naturally occurring metals, many of which are essential nutrients.
- Sporadic elevated concentrations not linked to facility activities.
- Lack of sufficient ecological habitat from long-term and/or continued future industrial, residential, and agricultural usage of many portions of the site.
- Removal of select concentrations of metals during excavations for lead and/or benzo(a)pyrene, thus reducing the overall HQs.

HHRA Notes on areas with Non-Carcinogenic risks exceeding 1. (child)

North Tank Farm total NC=3; surface soil =2; no target organ contributors or individuals>1
Cobalt and Iron, home produce and beef

Lorraine total NC=3; surface soil=3; no target organ contributors or individuals>1
Cobalt and Iron, home produce and beef

Loading Dock total NC=6; surface soil=5; no target organ contributors
Cobalt: due to ingestion of produce and beef; high degree of uncertainty in the models because these pathways model potential health impacts from surface soil concentrations; Cobalt: the 95UCL (15.2mg/kg) is slightly higher than background (11.1mg/kg UPL)-no concern

Loading Dock total NC=2; subsurface soil; no target organ contributors

East Tank Farm total NC=3; surface soil =3; no target organ contributors or individuals>1

Wilcox total NC=60; surface soil=10, GW=50 Co, Cu, Fe, BaP?

Total NC=96; surface soil 3, GW 93 (adults)

Total NC=33/12 (construction/commercial)

Cobalt, copper, iron: due to ingestion of produce and beef; high degree of uncertainty in the models because these pathways are models from surface soil concentrations; Cobalt: the 95UCL (3.87mg/kg) is lower than background (11.1mg/kg UPL)-no concern

Copper: 95UCL influence by 1 sample result at 7490 mg/kg (collocated with lead)

Iron: maximum detected concentration of 47,500 mg/kg at WPA-SB-27-0.5 exceeds the background UPL of 14,700 mg/kg; however, does not exceed the full residential soil RSL of 55,000 mg/kg. As a result of the uncertainty associated with the homegrown produce and beef ingestion exposure routes and overall chemical concentrations, cobalt, copper, and iron are not considered COCs for the site.

Residential Yards total adult=2, no target organ contributors or individuals>1
total NC=9.6 (child) soil ingestion

- Cadmium=1: residential yard; max value used which is located on the wilcox process area; 95UCLM is below the RSL of 71, with the mean at 6 mg/kg
- Cobalt=2.6: residential yard; Cobalt is consistent with background, 95UCLM is lower than background UTL
- Iron=1.3: residential yard;

Cadmium and cobalt were the COPCs with noncarcinogenic hazards above 1, and benzo(a)pyrene and arsenic are the primary contributors to carcinogenic risks. It is noted that the assessment of the residential yards used the maximum detected concentration.

Additionally, risk concerns identified for soil also include the ingestion of homegrown produce. As noted previously, these exposure routes are modeled on conservative parameters and likely overestimate risks.

The maximum detected concentration of cobalt in surface soil was 61.2 mg/kg (sample location WO-021-005-06-51) and a 95%UCLM of 3.69 mg/kg (Table 3.16). The 95%UCLM of cobalt is below the background UTL of 11.1 mg/kg (Table 2.16). This reveals the overall distribution of cobalt concentrations across the residential yards is consistent with background concentrations. Additionally, the maximum detected concentration of cobalt at residential location WO-021 is six times higher than the next detect of 10.9 mg/kg. The 95UCL for cobalt at location WO-021 15.0 mg/kg, which would result in a noncarcinogenic hazard less than 1 for cobalt. Therefore, cobalt is not retained as a COPC for the residential yards.

The background cadmium (average or 95UCL) could not be calculated because it was detected in only one background sample while all others were non-detect. The non-carcinogenic hazard of 2 is a result of direct contact with soil and ingestion of homegrown produce. The ingestion of homegrown produce is a modeled exposure pathway with high uncertainty. Additionally, these risk results are based upon the maximum detected concentration of 80.2 at WO-008-001. The next highest detection of cadmium at WO-008 was 2.2 mg/kg. Additionally, the overall 95%UCLM of cadmium was 0.23 mg/kg and the arithmetic mean was 6.07 mg/kg of all residential yards combined (Table 3.16). Both of these are below the EPA RSL of 71 mg/kg. This reveals that cadmium concentrations are not a concern across the residential yards and is not retained as a COPC.

Arsenic and benzo(a)pyrene were the primary contributors to carcinogenic risks of 1×10^{-4} within the residential yards. Similar to cadmium, the 95UCL for arsenic (3.29 mg/kg) and benzo(a)pyrene (0.148 mg/kg) are an order of magnitude lower than the maximum detected concentration used in the risk calculations (Table 3.16). This reveals the overall distribution of arsenic and benzo(a)pyrene in the residential yards is not a concern.

HHRA 2.4.1

For consideration of exposures to more than one chemical causing systemic toxicity via several different pathways, the individual HQs are summed to provide an overall hazard index (HI). If the HI is less than 1.0, then no adverse health effects are likely to be associated with exposures at the site. However, if the total HI is greater than 1.0, separate endpoint-specific HIs may be calculated based on toxic endpoint of concern or target organ (e.g., HQs for neurotoxins are summed separately from HQs for renal toxins). Only if an endpoint-specific HI is greater than 1.0 is there reason for concern about potential health effects for that endpoint.

Application of the PRGs across the sites based on current land use and future expected land use.

Area	Current Use	Future Use	Proposed Use for FS and PRG application	Justification
North Tank Farm	Residential	Residential	Residential	No Further Action
	Commercial/Industrial	Commercial/Industrial	Residential/Commercial/Industrial	No Further Action
East Tank Farm	Residential	Residential	Residential	Current and future use expected to remain unchanged; Lead PRG Residential
	Agricultural/Livestock	Residential/Agricultural/Livestock	Residential	Current and future use expected to remain unchanged; Lead PRG Residential
Lorraine Process Area	Residential	Residential	Residential	Current and future use expected to remain unchanged; Lead PRG Residential Note: <ul style="list-style-type: none"> • Benzo(a)pyrene is currently under review. • Ground water is currently under review, and may require ICs.)
Wilcox Process Area	Residential	Residential/Commercial/Industrial	Residential/Commercial/Industrial	Current and future use expected to remain unchanged; Lead PRG residential portions and Lead PRG residential/Industrial portions Note: <ul style="list-style-type: none"> • Benzo(a)pyrene is currently under review. • Ground water is currently under review, and may require ICs.)
Loading Dock Area	Commercial/Industrial	Commercial/Industrial	Residential Commercial/Industrial	Note: <ul style="list-style-type: none"> • Benzo(a)pyrene is currently under review.

Comparison of estimated volumes based on variations in Future Land Use.

Scenario	Land Uses	Volume at 1ft depth (cubic yards/tons)	Estimated Cost ¹ excavate/dispose	Total Estimated Cost
(1) Site-wide residential	Residential	14,069/20,681	\$436,139/\$827, 257	\$1,263,396
(2) Residential/WPA partial Industrial	All residential with back portion of Wilcox Industrial	10,518/15,461	\$326,058/\$618,458	\$944,516
(3) Residential/Industrial	Residential with NTF, LDA and Wilcox Industrial	8,731/12,835	\$270,661/\$513,383	\$784,044
(4) Residential/Industrial, Wilcox partial residential	Residential including Wilcox residence; NTF, LDA, and Partial Wilcox Industrial	8,974/13,192	\$278,194/\$527,671	\$805,865
(5) Residential/Industrial	Residential, Wilcox partial residential; LDA and Wilcox partial industrial	9,250/13,596	\$286,750/\$543,900	\$830,650

1-cost is provided as a rough comparison and is based on the estimates provided in the 2019 Source Control remedial design. transportation and disposal costs estimated at \$40/ton. Cubic yard estimates are converted to tons using 1.47cy/ton. Estimates for excavation are provided as either \$22/cy or \$39/cy so the average (\$31) is used in this comparison. Yellow highlights the proposed application of PRGs.

Based on the differences between the proposed application of PRGs and the expanded use of the Industrial PRGs, the proposed application can be met at a reasonable cost and volume increase. The proposed application includes an increase of approximately 1,787 cubic yards and a cost of \$160, 472. This minimal increase results in the use of ICs on one property rather than 3 properties. Overall, this increase is approximately 20%.

Note: this estimate is for 1ft depth, volume will increase should excavation be necessary down to 2ft under the residential scenario (2ft depth would be the limit of soil excavation.)

Note: this also assumes that the lead additive area, addressed under the interim action, will not leave lead concentrations that need to be addressed under this final action. If at the completion of the interim action, lead concentrations exceed the selected PRG then this additional volume will need to be included in the final remedy.

Proposed cleanup strategy for an excavation/offsite disposal alternative: Excavation would target the upper foot, using XRF to screen bottom of excavation for PRGS, either additional removal is needed, but no deeper than 2 ft, or excavation is complete and

confirmation sample is collected. Area will be backfilled if there is not enough surrounding soil to grade properly for drainage or the area is too large to regrade for drainage.

3551 cubic yards to address wilcox to residential

$3794 * 1.4 = 5311$ tons $5311 * 40 = 212464$ $3794 * 31 = 117,614$ \$318,880

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Ecological

- The risk assessment did determine that potential risks associated with exposures to lead in site soil (all 5 areas) are present for plants, insectivorous mammals, insectivorous birds, and herbivorous birds.
- The risk assessment did determine that potential risks associated with exposures to copper and vanadium in the site soil (all 5 areas) are present for plants, soil invertebrates, and insectivorous birds.

- Potential risks to aquatic organisms in the ponds from elevated concentrations of constituents in the water column (cadmium, lead, BaPyrene) are likely to be reduced following removal of contaminated soil in the upland.
- Concentrations of Total PAHs in stream sediment, when compared to the probable effects level (PEL) of 16.8 mg/kg (MacDonald et al 1996) indicates no potential risk to benthic organisms from total PAHs in stream sediments.
- Because of infrequent detection of volatile organic compounds, volatile nature of the chemicals, absence of direct toxicological studies, and the unsubstantiated theoretical nature of the soil screening values, it is not expected that these VOCs would result in unacceptable risk to populations of soil invertebrates.
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 - Low potential for uptake and toxicity from naturally occurring metals, many of which are essential nutrients.
 - Sporadic elevated concentrations not linked to facility activities.
 - Lack of sufficient ecological habitat from long-term and/or continued future industrial, residential, and agricultural usage of many portions of the site.
 - Removal of select concentrations of metals during excavations for lead and/or benzo(a)pyrene, thus reducing the overall HQs.